

Application No. 10/054,487.

Reply to final Office Action of January 15, 2004

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A device for providing a medical fluid to a patient comprising:
a plurality of capacitor plates ~~spaced apart~~ positioned in a fixed relation to one another;
a fluid receptacle positioned between the plurality of capacitor plates;
a circuit electrically connected to the plurality of capacitor plates, the circuit having an output indicative of a volume of the fluid in the fluid receptacle; and
a member for providing at least a portion of the volume of the fluid to or from a patient.

Claim 2 (original): The device of Claim 1, wherein the receptacle operates with a pump chamber having at least one fluid port.

Claim 3 (original): The device of Claim 2, wherein the capacitor plates have a shape that is substantially the same as the shape of the pump chamber.

Claim 4 (original): The device of Claim 1, wherein the receptacle includes at least one flexible membrane wall movable to pump medical fluid.

Claim 5 (original): The device of Claim 1, wherein the receptacle includes first and second flexible membrane walls, at least one of the first and second membrane walls being movable to change a volume of the receptacle.

Claim 6 (original): The device of Claim 1, wherein the receptacle includes a portion of a disposable dialysis fluid flow path useable with a dialysis machine.

Claim 7 (original): The device of Claim 1, wherein at least one capacitor plate of the plurality of capacitor plates has a non-planer shape.

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Claim 8 (original): The device of Claim 1, wherein the capacitor plates have a shape substantially the same as the fluid receptacle when the fluid receptacle is substantially full of fluid; and the circuit charges the capacitor plates and measures a change in voltage from the capacitor plates over a time interval.

Claim 10 (original): The device of Claim 1, wherein the circuit further comprises:
a ground connection to one of the capacitor plates; and
a capacitance sensor circuit connected to another capacitor plate.

Claim 11 (original): The device of Claim 1, which includes a pair of substantially parallel capacitor plates.

Claim 12 (previously presented): A device for providing dialysis to a patient comprising:
a plurality of capacitor plates;
a receptacle for holding a volume of dialysis fluid positioned between the plurality of capacitor plates, the receptacle operable to enable a relatively low dielectric fluid to be present at certain times between the receptacle and the plates;
a circuit electrically connected to the plurality of capacitor plates, the circuit having an output indicative of the volume of dialysis fluid in the receptacle; and
a fluid line coupled to the patient to deliver at least a portion of the volume of dialysis fluid to or from the patient.

Claim 13 (original): A device for providing continuous flow peritoneal dialysis comprising:
a dialysis receptacle capable of being placed in fluid communication with a patient;
first and second capacitor plates having a variable dielectric between the plates that is dependent on an amount of dialysis fluid in the receptacle; and
an electrical circuit connected to the capacitor plates that creates a signal that is related to the variable dielectric.

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Claim 14 (original): A system for measuring a volume of a fluid to be provided to or from a patient, the system comprising:

a fluid receptacle capable of being fluidly connected to a patient;

first and second capacitor plates having a variable dielectric between the plates that is dependent on an amount of a fluid in the fluid receptacle; and

an electrical circuit connected to the capacitor plates that creates a signal that is related to the variable dielectric.

Claim 15 (original): The system of Claim 14, wherein the signal is indicative of the volume of the fluid in the fluid receptacle.

Claim 16 (original): The system of Claim 14, wherein the signal is indicative of a volume of air in the fluid receptacle.

Claim 17 (original): The system of Claim 14, wherein the signal is indicative of a portion of fluid and a portion of air in the fluid receptacle.

Claim 18 (original): The system of Claim 14, wherein the fluid receptacle operates inside of a fluid pump chamber.

Claim 19 (original): The system of Claim 18, wherein the capacitor plates have a shape

Claim 20 (original): The system of Claim 14, wherein the fluid receptacle is positioned between the first and second capacitor plates.

Claim 21 (withdrawn): The system of Claim 14, further comprising a pump piston, wherein one of the first and second capacitor plates defines an aperture that allows a portion of the piston to extend outside the plate.

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Claim 22 (withdrawn): The system of Claim 14, further comprising a pump piston, wherein the pump piston moves between the capacitor plates.

Claim 23 (original): The system of Claim 14, further comprising a displacement fluid that expands and contracts the fluid receptacle to fill and empty the fluid in and out of the receptacle.

Claim 24 (original): The system of Claim 14, which includes a pump chamber wall defining a port that can apply a negative pressure to the receptacle and pull at least a portion of the membrane towards the port.

Claim 25 (original): The system of Claim 14, which includes a pair of pump chamber walls each defining a port.

Claim 26 (original): The system of Claim 14, wherein at least one of the first and second capacitor plates is represented by the surface of the adjacent fluid.

Claim 27 (original): The system of Claim 14, wherein the fluid receptacle further comprises a disposable cassette, at least one wall of the cassette being a flexible membrane.

Claim 28 (original): The system of Claim 14, further comprising a processor that determines a volume of the fluid from the signal outputted by the electrical circuit.

Claim 29 (original): The system of Claim 14, further comprising a processor that determines a cumulative volume of fluid from a plurality of individual volumes of fluid in the fluid receptacle.

Claim 30 (original): The system of Claim 14, wherein the pair of capacitor plates have a shape substantially the same as the receptacle when the receptacle is full of fluid.

Claim 31 (previously presented): A system for measuring a volume of a fluid to be provided to or from a patient, the system comprising:

- a fluid receptacle that can be placed in fluid communication with the patient;
- first and second capacitor plates positioned outside of the fluid receptacle and fixed spatially with respect to each other; and
- an electrical circuit providing a voltage source that enables a signal indicative of the volume of the fluid in the receptacle to be generated.

Claim 32 (original): The system of Claim 31, wherein the output signal is based on at least one of: a variable dielectric between the plates, a changing surface area of one of the plates, and a changing distance between the plates.

Claim 33 (original): The system of Claim 31, wherein the signal is based on a varying dielectric constant between the fluid and air.

Claim 34 (original): The system of Claim 31, wherein the circuit charges the capacitor plates and measures a change in voltage from the capacitor plates over a time interval.

Claim 35 (original): The system of Claim 34, wherein the time interval is a fixed time interval.

Claim 36 (previously presented): A medical fluid delivery system, comprising:

- a fluid flow path including a patient connection;
- a fluid receptacle positioned inside a chamber, the receptacle so constructed and arranged to be in fluid communication with the fluid flow path; and
- a capacitance sensor positioned relative to the fluid receptacle and capable of accounting for an amount of a relatively low dielectric fluid existing between the receptacle and the housing to indicate a volume of fluid in the receptacle.

Claim 37 (original): The system of Claim 36, wherein the fluid receptacle operates with a pump chamber.

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Claim 38 (original): The system of Claim 37, wherein the capacitance sensor further comprises first and second capacitor plates at opposite sides of the pump chamber.

Claim 39 (original): The system of Claim 38, wherein the capacitor plates have a shape substantially the same as part of the pump chamber.

Claim 40 (original): The system of Claim 36, wherein the capacitance sensor further comprises first and second capacitor plates positioned at opposite sides of the fluid receptacle.

Claim 41 (original): The system of Claim 36, wherein the capacitance sensor includes at least one capacitor plate having a non-planar shape.

Claim 42 (original): The system of Claim 36, wherein the fluid receptacle is part of a disposable set.

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Claim 38 (original): The system of Claim 37, wherein the capacitance sensor further comprises first and second capacitor plates at opposite sides of the pump chamber.

Claim 39 (original): The system of Claim 38, wherein the capacitor plates have a shape substantially the same as part of the pump chamber.

Claim 40 (original): The system of Claim 36, wherein the capacitance sensor further comprises first and second capacitor plates positioned at opposite sides of the fluid receptacle.

Claim 41 (original): The system of Claim 36, wherein the capacitance sensor includes at least one capacitor plate having a non-planer shape.

Claim 42 (original): The system of Claim 36, wherein the fluid receptacle is part of a disposable set.

Claim 43 (original): The system of Claim 36, wherein the capacitance sensor comprises first and second capacitor plates and an electrical circuit connected to the plates.

Claim 44 (original): The system of Claim 36, wherein the pair of capacitor plates have a shape substantially the same as the fluid receptacle when the fluid receptacle is substantially full of fluid.

Claim 45 (original): The system of Claim 36, wherein the medical fluid delivery system is a dialysis system.

Claim 46 (original): The system of Claim 45, wherein the dialysis system is a continuous flow peritoneal dialysis system.

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Claim 47 (previously presented): A dialysis system, comprising:

a fluid flow mechanism capable of conveying a fluid during a dialysis treatment; and
a fluid volume capacitance sensor so positioned and arranged in a fixed relationship on opposing sides of the fluid flow mechanism to measure a volume of the fluid during the dialysis treatment.

Claim 48 (original): The dialysis system of Claim 47, wherein the fluid flow mechanism is a continuous flow mechanism capable of performing continuous flow dialysis.

Claim 49 (original): The dialysis system of Claim 47, wherein the fluid flow mechanism is fluidly connected to a peritoneal dialysis catheter.

Claim 50 (original): The dialysis system of Claim 47, wherein the fluid flow mechanism is fluidly connected to a plurality of peritoneal access lumens.

Claim 51 (previously presented): A method of measuring a volume of a medical fluid pumped by a fluid pump, comprising the steps of:

sensing a first state of a fluid receptacle with capacitor plates when the medical fluid receptacle is substantially empty of fluid so that a relatively low dielectric fluid exists between the plates and the receptacle;

providing the medical fluid to the fluid receptacle;

sensing a second state of the fluid receptacle with the capacitor plates when the fluid receptacle is substantially full of medical fluid; and

determining a volume of the medical fluid in the fluid receptacle based on the first and second states sensed by the capacitor plates.

Claim 52 (original): The method of Claim 51 further comprising the steps of:

substantially emptying the fluid receptacle of fluid; and

providing additional medical fluid to the receptacle, sensing another second state, and determining another volume of the medical fluid.

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Claim 53 (original): The method of Claim 51, which includes continuously sensing the state of the fluid receptacle as the fluid enters the receptacle.

Claim 54 (original): The method of Claim 51, which includes determining a total volume of fluid from a plurality of volumes of medical fluid provided to the receptacle.

Claim 55 (original): The method of Claim 51, which includes knowing a total amount of medical fluid needed by a patient and stopping the provision of the medical fluid when the total amount has been provided.

Claim 56 (original): The method of Claim 51, which includes determining a volume of air in the fluid receptacle based on the first and second states sensed by the capacitor plates.

Claim 57 (currently amended): A method of providing dialysis to a patient, comprising the steps of:

measuring a volume of dialysis fluid having a sequentially changing inverse relationship with a different relatively low dielectric fluid with a capacitance sensor; and
passing a portion of the volume of the dialysis fluid into a portion of a patient.

Claim 58 (original): The method of Claim 57, wherein the portion includes a peritoneal cavity of the patient.

Claim 59 (original): The method of Claim 57, wherein the measuring step further comprises measuring the volume of dialysis fluid in a pump chamber.

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Claim 60 (currently amended): A method of providing continuous flow peritoneal dialysis to a patient, comprising the steps of:

passing a volume of dialysis fluid through a pair of capacitor plates ~~spaced apart~~ positioned in a fixed relation to one another to measure the volume of dialysis fluid;
causing the volume of dialysis fluid to move into a portion of a patient; and
removing dialysis fluid from the patient simultaneously as the volume of dialysis fluid is moved into the patient.

Claim 61 (original): The method of Claim 60, wherein passing the volume of dialysis fluid through the pair of capacitor plates occurs at a fluid pump.

Claim 62 (currently amended): A method of providing dialysis to a patient, comprising the steps of:

providing a dialysate;
measuring a volume of dialysate that changes, replacing or being replaced by a different lower dielectric fluid, inside a fixed volume chamber with a capacitance sensor coupled to the chamber;
infusing the volume of dialysate into a patient; and
drawing the dialysate from the patient.

Claim 63 (original): The method of Claim 62, which includes infusing dialysate into the patient using a continuous flow peritoneal dialysis method.

Claim 64 (original): The method of Claim 62, which includes visually indicating the measured volume to a person.

Claim 65 (original): The method of Claim 62, wherein the measuring step further comprises measuring the volume of dialysis fluid in a pump chamber.

Claim 66 (original): The method of Claim 62, which includes measuring a volume of air with the capacitance sensor.

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Claim 67 (currently amended): A method of operating a system which displaces a medical fluid that is designed to be received by a patient, comprising the steps of:

moving the medical fluid from a first location to a second location; and

~~measuring a volume of the fluid moved to displace a volume of a different relatively low~~
dielectric fluid by a capacitance sensor.

Claim 68 (original): The method of Claim 67, wherein the measuring step further comprises measuring the volume of fluid in a pump chamber.

Claim 69 (original): The method of Claim 67, further comprising the step of delivering the medical fluid to a patient.

Claim 70 (original): The method of Claim 67, further comprising the step of performing dialysis with the medical fluid.

Claim 71 (original): The method of Claim 70, wherein the performing dialysis step further comprises performing continuous flow peritoneal dialysis.

Claim 72 (original): The method of Claim 67, which includes controlling an amount of the medical fluid needed to be moved by measuring the volume with the capacitance sensor.

Claim 73 (original): The method of Claim 67, which includes indicating the amount of medical fluid moved to a patient.